

## NUTRIENTS ANNEX

### OVERVIEW

In some areas of the Great Lakes, excess phosphorus loadings threaten the Great Lakes ecosystem by contributing to harmful and nuisance algal blooms that can cause drinking water impairments, exacerbate dead zones<sup>1</sup>, and drive beach closures that result in loss of recreational opportunities. In response to these nutrient-induced impairments, the United States and Canada commit to coordinating binational actions to manage phosphorus loadings and concentrations in the waters of the Great Lakes under the Nutrients Annex of the 2012 GLWQA. Recognizing the magnitude of the threat to Lake Erie in particular, the 2012 Agreement requires Canada and the United States to establish phosphorus load reduction targets, allocated by country for the nearshore and open waters of Lake Erie, by 2016. Domestic Action Plans to achieve the Lake Erie targets must be developed by 2018.

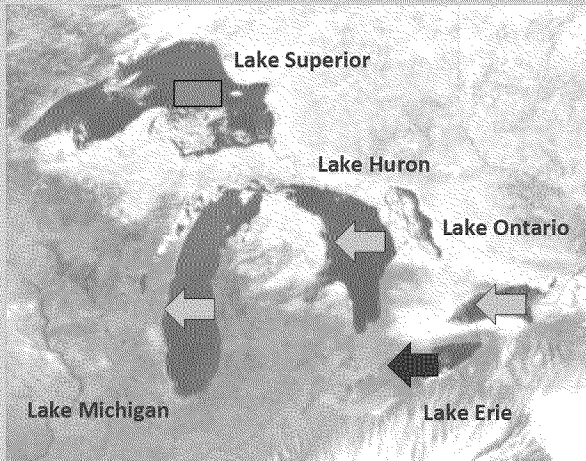
To combat the growing threat of toxic and nuisance algal development in Lake Erie, the United States and Canada adopted new phosphorus reduction targets for major tributaries and priority watersheds in the Lake Erie basin on February 22, 2016, following a robust binational science-based process and an extensive public consultation. The Parties and multiple partner agencies are now working to develop Domestic Action Plans to meet the 2018 deadline.

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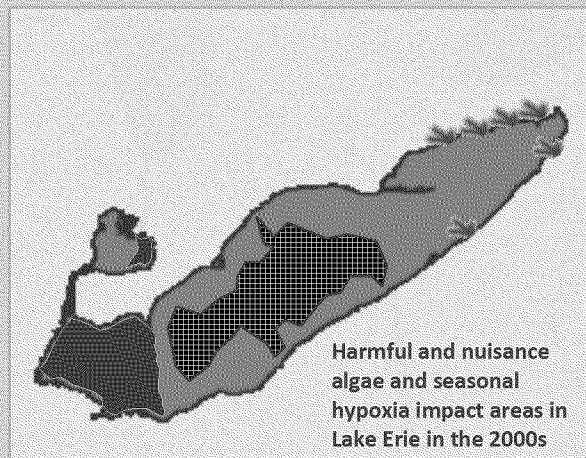
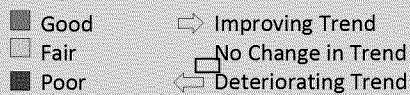
<sup>1</sup> Excess phosphorus contributes to hypoxic conditions (i.e. low-oxygen conditions) in the cold bottom layer of the Lake Erie – when algae die, they decompose by a process that uses cellular respiration, which uses up oxygen; this can leaving little to no oxygen for the aquatic community which either suffocates or moves elsewhere, creating Lake Erie’s “Dead Zone.”

## Lake Erie

### Most Impacted & Our Highest Priority



State of the Great Lakes, 2016 Draft Assessment of the Nutrients in Lakes Sub-indicator



Harmful and nuisance algae:

■ Cyanobacteria

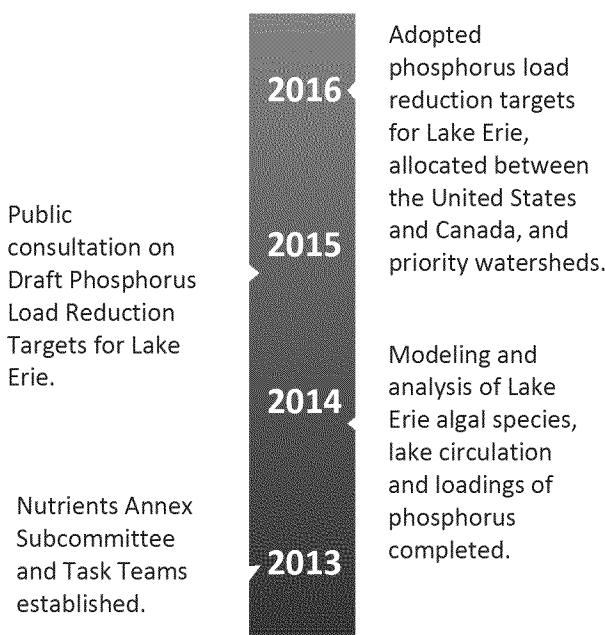
■ Cladophora

Seasonal hypoxia:



Low oxygen conditions exacerbated by excess nutrients

## PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annex's implementation is supported by the Nutrients Annex Subcommittee, co-led by the United States Environmental Protection Agency and Environment and Climate Change Canada. Organizations on the subcommittee include:



## BINATIONAL ACTIONS TAKEN

**By 2016, develop binational substance objectives for phosphorus concentrations, loading targets, and loading allocations for Lake Erie.**

- The Lake Erie algae problem was defined in relation to three main basins of the Lake – the Western Basin, the Central Basin and the Eastern Basin. Information on algal patterns and species, lake circulation, and sources and loadings of phosphorus were studied and modeling experts from Canada and the United States used nine different computer simulation models to correlate changes in phosphorus levels with levels of algal growth. By comparing and contrasting the results of these models, draft phosphorus load reduction targets to achieve the Lake Ecosystem Objectives for Lake Erie.
- Information about the draft targets was made available online, for approximately 60 days up to August 31, 2106, through [www.binational.net](http://www.binational.net), and Environment and Climate Change Canada and United States Environmental Protection Agency websites. The Parties also reached out through a number of binational and domestic face-to-face meetings with interested stakeholders and partners including agricultural commodity groups, municipalities, Conservation Authorities, First Nations, non-government organizations, and others. Feedback received included both technical comments on the targets as well as ideas for action.

- Following this robust science-based process and public consultation, Canada and the United States adopted the following phosphorus reduction targets for Lake Erie (compared to a 2008 baseline):
  - **To minimize the extent of hypoxic zones in the waters of the central basin of Lake Erie:** a 40 percent reduction in total phosphorus entering the western and central basins of Lake Erie—from the United States and from Canada—to achieve an annual load of 6,000 metric tons to the central basin. This amounts to a reduction from the United States and Canada of 3,316 metric tons and 212 metric tons respectively.
  - **To maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters of the western and central basins of Lake Erie:** a 40 percent reduction in spring total and soluble reactive phosphorus loads from the following watersheds where algae is a localized problem: in Canada, Thames River and Leamington tributaries; and in the United States, Maumee River, River Raisin, Portage River, Toussaint Creek, Sandusky River and Huron River (Ohio).
  - **To maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the waters of the western basin of Lake Erie:** a 40 percent reduction in spring total and soluble reactive phosphorus loads from the Maumee River in the United States.
- Further science and analysis is needed to establish targets that will minimize impacts from nuisance algae in the eastern basin of Lake Erie.

**By 2018, develop binational phosphorus reduction strategies and domestic action plans to meet the objectives for phosphorus concentrations and loading targets in Lake Erie.**

- The United States and Canada are working with multiple partner agencies, tribes, First Nations, Métis, and stakeholders to develop a binational phosphorous reduction strategy and Domestic Action Plans. These plans will identify the actions required to meet the agreed to load reduction targets. Stakeholders are being engaged during the development process, and the draft plans will be available for further consultation in 2017.

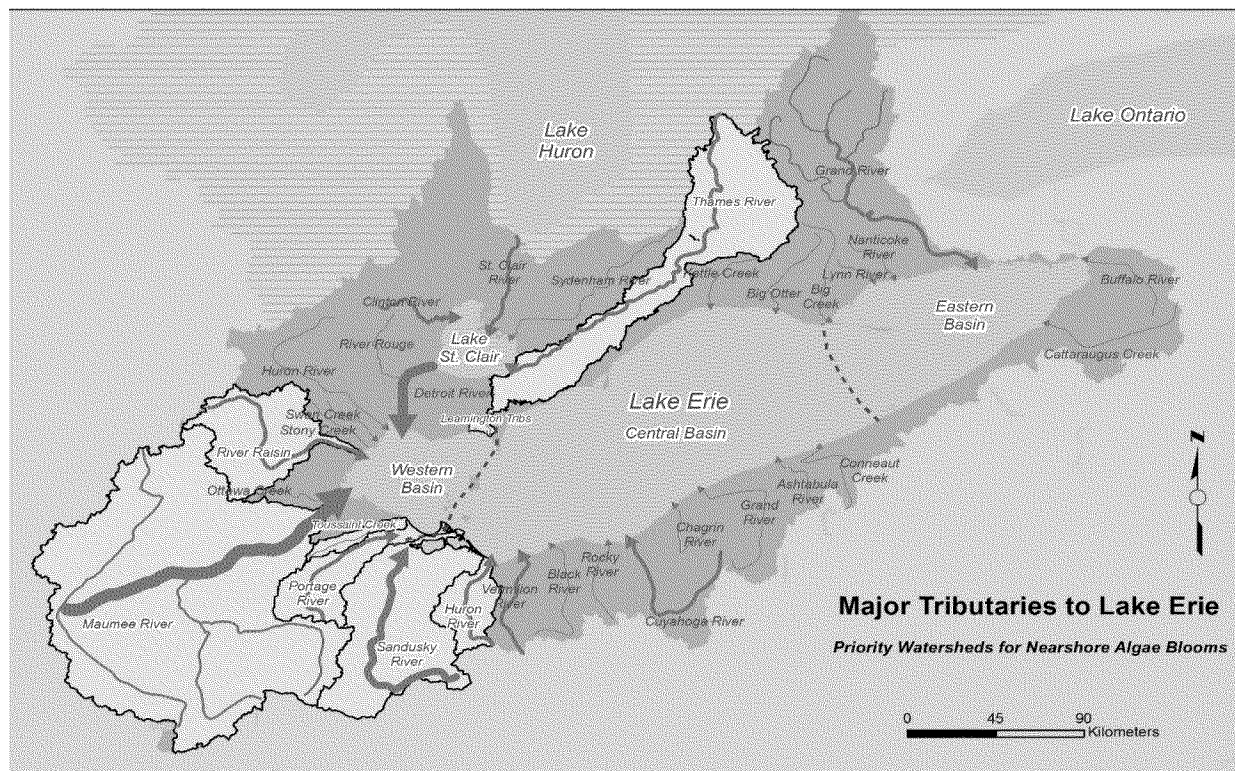
**Assessing, developing, and implementing programs to reduce phosphorus loadings from urban, rural, industrial and agricultural sources.**

- Ongoing efforts to limit excess phosphorus loading to the Great Lakes – through detergent bans, optimizing sewage treatment, and implementing best management practices on agricultural lands – must continue and be enhanced with better targeting and adoption. Work is underway to evaluate the existing programs in Canada and the United States, identify opportunities to maximize our phosphorus reduction efforts, and propose new programs or approaches to manage phosphorus loadings from municipal and agricultural point and nonpoint sources.

**Identifying priority watersheds that contribute significantly to local algae development, and implementing management plans to achieve phosphorus load reduction targets and controls for these areas.**

- The United States and Canada identified eight priority watersheds – two in Canada and six in the

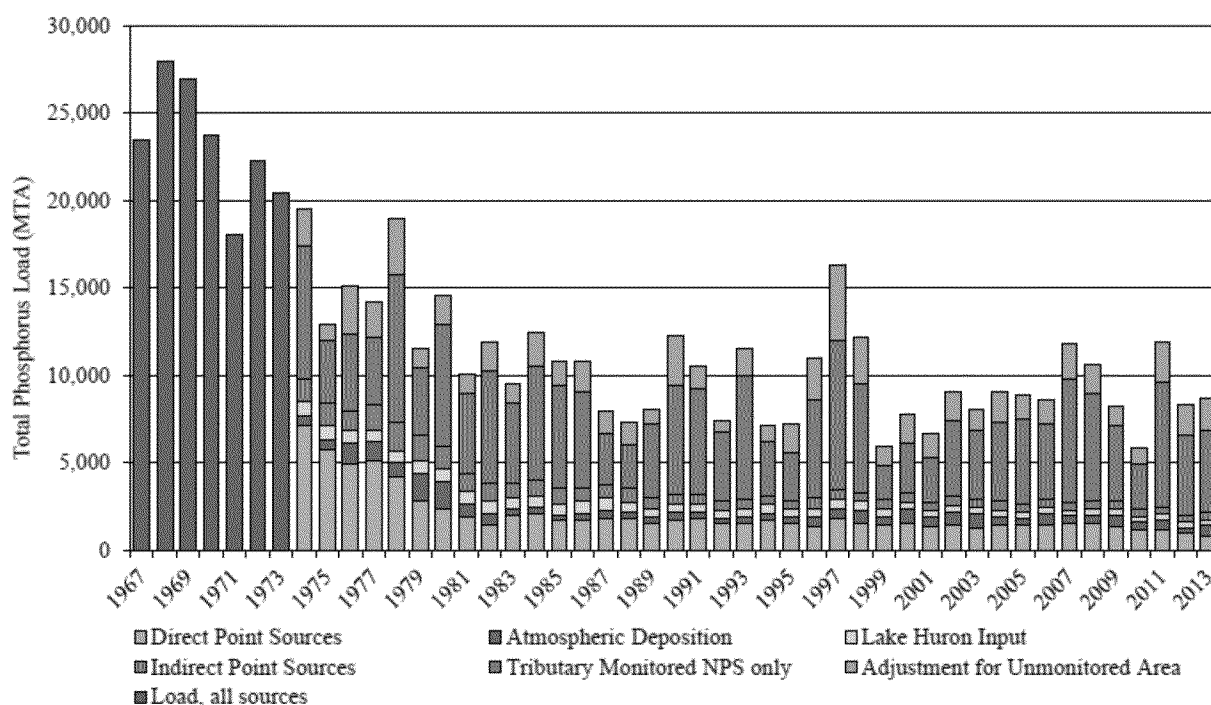
United States – for phosphorus control to address algal blooms occurring in the nearshore waters of Lake Erie [reference figure].



**Figure X: 2008 Baseline Phosphorus loads for major tributaries to Lake Erie and the priority watersheds for nearshore blooms.** Domestic action plans will further prioritize watershed implementation efforts to meet the new phosphorus load reduction goals.

**Undertake and share research, monitoring and modeling necessary to establish, report on and assess the management of phosphorus and other nutrients and improve the understanding of relevant issues associated with nutrients and excessive algal blooms.**

- Canada and the United States engaged many scientific experts in the development of the new phosphorus loading targets for Lake Erie, and are currently developing an approach to monitor and track progress towards the new targets. The following priorities for research, monitoring and modeling have been identified:
- Monitoring of total phosphorus and dissolved reactive phosphorus loads and harmful algal blooms and hypoxia extent and duration to evaluate effectiveness of load reduction efforts and the lake's response over time;
- Research on factors that contribute to harmful algal bloom toxin production;
- Better understanding of internal phosphorus loads;
  - Factors controlling the growth of the nuisance alga, *Cladophora*; and
  - Improvement of ecosystem models to understand the relationship between external, internal Phosphorus loads and algal blooms.



**Total phosphorus loads to Lake Erie by source type, 1967 – 2013.**

- As shown in the above chart [reference figure], under the previous 1987 GLWQA targets, Canada and the United States tracked phosphorus loads and sources on a whole-lake basis. The new targets for Lake Erie are refined to specific locations, forms of phosphorus, and time of year. Going forward, tracking and assessments related to these new targets will need refinement and appropriate data collection will be critical to the evaluation of implementation efforts and the Lake's response over time.



- The United States has several permitting and funding programs to reduce phosphorus loadings from municipal, industrial and agricultural sources. For example, state environmental and agricultural programs establish discharge limits and comprehensive nutrient management plans to manage nutrient pollution. Since 2008, \$314 million in Farm Bill funding has supported conservation activities on 2.5 million acres of private land throughout the Great Lakes region. Since fiscal year 2010, over 410 nutrient reduction projects have been implemented in the Maumee River watershed with Great Lakes Restoration Initiative (GLRI) and United States Environmental Protection Agency Nonpoint Source Program funds. A new United States Department of Agriculture Natural Resources Conservation Service initiative launched in 2016 will help landowners reduce phosphorus runoff from farms by more than 640,000 pounds each year by effectively doubling the acres under

conservation in the Western basin over the course of the three-year investment.

- Through the GLRI, federal agencies and their partners are reducing nutrient loads into the Great Lakes. During fiscal year 2015, federal agencies and their partners funded nutrient and sediment reduction projects on over 100,000 acres of targeted watershed in the Great Lakes Basin. These projects are projected to prevent over 160,000 pounds of phosphorus from entering the Great Lakes annually. During fiscal year 2015, federal agencies and their partners also funded urban runoff projects that are anticipated to capture an average annual volume of more than 37 million gallons of untreated urban runoff per year. These projects reduce flooding, increase green space in urban areas, and return vacant properties to productive use.
- The United States Geological Survey has installed 22 GLRI-funded edge-of-field monitoring stations on farms in the Maumee River basin, the Fox River basin, the Saginaw River basin and the Genesee River basin. These stations will gather weather data and sample runoff water during storm events. The water samples will be analyzed for their phosphorus, nitrogen, and sediment content. The United States Department of Agriculture-Natural Resources Conservation Service staff will assist the cooperating farmers with installing conservation practices in the field above the stations. This analysis will help quantify the value of conservation practices in reducing sediment and nutrient delivery from these fields, under these conditions, in order to improve water quality.
- The GLRI is also funding the implementation of conservation practices including cover crops, silage leachate containment areas, a waste storage structure, and nutrient management on conservation demonstration farms in the Fox River basin. The farms are open for annual tours where other farmers in the watershed can view the installed practices, hear farmers' opinions on the value that conservation farming practices can add to their farming operations, and ask questions.
- GLRI-funded research led by the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory, in collaboration with partners from the University of Michigan's Cooperative Institute for Limnology and Ecosystems Research, is investigating impact of land use changes on algal bloom development in the western basin of Lake Erie and in Lake Huron's Saginaw Bay. The Great Lakes Environmental Research Laboratory combines remote sensing, monitoring, and modeling to produce weekly forecasts of *Microcystin* bloom concentration and transport in Lake Erie, which are distributed to regional stakeholders. National Oceanic and Atmospheric Administration researchers, with their partners at Heidelberg University, have also initiated early season projections of the seasonal harmful algal bloom severity in western Lake Erie.
- During fiscal year 2015, GLRI partners established a network of four real-time continuous observing buoys to track detailed water quality conditions to support modeling, forecasting, and public warnings of harmful algal bloom conditions throughout western Lake Erie. The observing buoys are capable of tracking water quality and bloom conditions and measuring dissolved phosphorus concentrations at hourly intervals. During the 2015 bloom season, these buoys collected over 7,000 in-lake nutrient and water quality measurements, providing unprecedented spatial and temporal details of internal lake dynamics and bloom development. In addition to providing real-time tracking of harmful algal bloom conditions for water intake managers and recreational users, the observing data will be used to improve ongoing forecasting efforts covering a range of spatial and temporal scales including seasonal harmful algal bloom forecasts, 5-day forecasts, and vertical distribution forecasts.

- In June 2015 Governor Rick Snyder of Michigan, Premier Kathleen Wynne of Ontario and Lieutenant Governor Mary Taylor of Ohio signed the Western Basin of Lake Erie Collaborative Agreement which establishes a collaborative initiative that will use adaptive management to achieve a recommended 40 percent total load reduction in the amount of total and dissolved reactive phosphorus entering the WLEB by the year 2025 with an aspirational interim goal of a 20 percent reduction by 2020. Each state and province commits to developing, with stakeholder involvement, a plan outlining their proposed actions and time lines toward achieving the phosphorus reduction goal.
- Michigan has finalized its 2016 Implementation Plan, which is the first step in achieving a 40% phosphorus reduction by 2025, for the Western Lake Erie Basin Collaborative (<http://glc.org/projects/water-quality/lent/>). The 2016 Implementation Plan can be found at Michigan's Department of Environmental Quality's Water Resources Division ([http://www.michigan.gov/documents/deq/wrd-western-lake-erie\\_503547\\_7.pdf](http://www.michigan.gov/documents/deq/wrd-western-lake-erie_503547_7.pdf)).
- Also in support of the Western Lake Erie Basin Collaborative, Ohio has released its draft Western Lake Erie Basin Collaborative Implementation Plan to reduce phosphorus entering Lake Erie by 40 percent by 2025. The plan was developed with input from various stakeholder groups and state agencies and is available at [epa.ohio.gov/Portals/33/documents/WLEBCollaborative.pdf](http://epa.ohio.gov/Portals/33/documents/WLEBCollaborative.pdf). Public comments are requested by June 25, 2016.
- Indiana is working with landowners in the communities to help improve the water quality of our streams and inland rivers, and ultimately Lake Erie. A summary of the Indiana Western Lake Erie Basin Initiatives can be found at the Indiana State Department of Agriculture (<http://www.in.gov/isda/3261.htm>).
- The Pennsylvania Vested in Environmental Sustainability (PA VinES) Program assists grape farmers in the Lake Erie Basin to improve environmental and economic sustainability of their agricultural operations. Pennsylvania DEP, with partners Penn State University, Cornell University, NRCS, Erie County Conservation District and the Pennsylvania Farm Bureau, developed a Grower Self-Assessment Workbook that helps identify on-farm opportunities to reduce non-point source pollution to Lake Erie tributaries and increase farm profitability. Pennsylvania DEP recently awarded Erie County Conservation District over \$360,000 in state grant funding to begin implementation of prioritized agricultural BMPs that are identified through the Grower Self-Assessments.
- In coordination with the Pennsylvania Lake Erie Harmful Algae Bloom (HAB) Task Force, Pennsylvania DEP began a strategic partnership with the Regional Science Consortium at Presque Isle to complete comprehensive monitoring of PA Lake Erie beaches and public areas for the presence of HAB conditions throughout the 2016 season. Also, DEP deployed a new real-time water quality monitoring buoy in Presque Isle Bay to collect data that will allow researchers to complete predictive modeling of potential HAB conditions.
- Pennsylvania DEP awarded \$150,000 in state grant funds to the non-profit Environment Erie to work with Lake Erie MS4 municipalities to plan for future stormwater infrastructure needs. This project will evaluate current operations and develop a tailored framework for each participating municipality to generate sustainable revenue through stormwater fees or utilities. Pennsylvania just recently authorized the ability of municipalities to form stormwater utilities, and this program looks to increase municipal capacity to improve MS4 operations to reduce urban stormwater-related



impairments such as excess nutrients, erosion and sedimentation, and flow variability.

- In June 2014, Congress reauthorized the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) by passing the Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2014 (HABHRCA 2014, P.L. 113-124). The reauthorization of HABHRCA acknowledged concerns related to HABs and hypoxia, extended the scope of the legislation to include freshwater HABs and hypoxia, and recognized the need for further coordinated action across the Federal sector to address these issues. Additionally, the legislation called for Federal agencies to provide integrated assessments on the causes and consequences of and approaches to reducing HABs and hypoxia nationally, with particular emphasis on the Great Lakes. Finally, the reauthorization included a specific focus on the needs of stakeholders, requiring that Federal agencies engage with stakeholders around the country.
- On August 7th, 2015, the President signed H.R. 212 (Drinking Water Protection Act) which directs EPA to develop and submit a strategic plan for assessing and managing risks associated with algal toxins in drinking water provided by public water systems. The resulting *Algal Toxin Risk Assessment and Management Strategic Plan for Drinking Water*, released in November 2015, includes steps and timelines to assess: algal toxins and their human health effects, health advisories, factors likely to cause HABs, treatment options, analytical methods, frequency of monitoring, treatment options, and source water protection practices.

## DOMESTIC ACTIONS TAKEN



- Canada and Ontario are taking action under the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, 2014 to reduce phosphorus loads to Lake Erie through urban, agricultural, rural and industrial or commercial point and non-point initiatives including ongoing infrastructure and agricultural stewardship programs. To further improve the effectiveness of current and future phosphorus reduction actions in Lake Erie, Canada and Ontario, along with their partners and stakeholders are working to review and where necessary implement changes to the existing program, policy and legislative phosphorus management frameworks.
- Canada's Great Lakes Nutrient Initiative (2012-2016) enhanced Environment and Climate Canada funding to support the critical science and policy development needed to support the establishment of new phosphorus reduction targets for Lake Erie. Initiative activities included:
  - enhanced water quality monitoring at key locations in the Lake Erie basin – including the Thames River, the Sydenham River, the Detroit River and the Grand River – in order to measure of phosphorus concentrations and loads from the Canadian portion of the Lake Erie basin;
  - new modeling and research to enhance understanding of the factors contributing to the reoccurrence of large scale outbreaks of toxic and nuisance algae in Lake Erie;
  - an assessment of current Canadian best practices and policy options for reducing loadings of

- phosphorus to Lake Erie in order to achieve targets;
  - an assessment of socio-economic costs of algal blooms in Lake Erie;
  - the development of inventories of phosphorus management programs;
  - cost-benefit modeling of phosphorus management in the Grand River basin; and,
  - an assessment of future trends and demographics in urban and agriculture landscapes in the Lake Erie basin.
- Canada's 2016 Federal Budget allocated \$3.1 million in 2016 to 2017 to Environment and Climate Change Canada to continue to improve nearshore water and ecosystem health by reducing phosphorus and the resulting algae in Lake Erie. With these resources, the focus will shift from setting phosphorus targets to achieving them, including developing a domestic action plan in collaboration with Ontario and other partners, and monitoring and reporting on progress.
- The governments of Ontario and Canada, through the Great Lakes Agricultural Stewardship Initiative (<http://www.ontariosoilcrop.org/oscia-programs/glasi/>), are supporting farmers in the Lake Erie and Lake St. Clair watersheds, and in Lake Huron's southeast shores watershed, implement Better Management Practices that reduce phosphorus loading to the Great Lakes.
- Ontario government researchers are adding to the understanding of harmful algal blooms and nuisance algae by monitoring nearshore water quality at 17 drinking water intake sites in the Great Lakes, including five locations in Lake Erie. The Government of Ontario also monitors 70 sites in nearshore areas of the Great Lakes to track long-term trends in Great Lakes water quality. These long-term data sets, together with special studies in the lakes and their tributaries, advance our understanding of nearshore responses to climate change and other stressors, including changes in nutrient loading.
- In 2013, the government of Ontario launched the Multi-Watershed Nutrient Study. The seven-year study will examine the management of agricultural land and the extent of nutrient runoff in 11 agricultural watersheds in the basins of Lakes Erie, Ontario and Huron. This will be an ongoing study to determine the role agriculture can play in resolving a very complex issue. Comparative data from previous studies will be used to track changing climate conditions, to develop a "then-and-now" analysis and to model future scenarios.

